

## EARTH-MOVING OPERATIONS

## CHAPTER 6

### EQUIPMENT

Earth moving may include site preparation, excavation and backfill, dredging, and preparing base and subbase. The type of equipment used can have a great effect on the man-hours and machine-hours required to complete a given amount of work. Before estimates can be prepared, a decision must be reached on the best method of operation and the type of equipment to be

used. Equipment selection should be based on efficient operation and availability of equipment. It is best to use any available equipment that can reduce the amount of manual labor required. Since most earth-moving operations can be performed by machines with operators, manual labor should be avoided.

### SITE PREPARATION

Site preparation includes clearing and grubbing operations such as removing, piling, and burning trees and brush; removing stumps; and loading and hauling cut trees and brush. Site preparation also includes

cut-and-fill earth-moving operations, removing existing asphalt and concrete structures (paving, walks, and curbs), excavating and hauling from cut areas, as well as spreading and compacting into fill areas.

### EXCAVATION AND BACKFILL

Excavation and backfill includes trenching and ditching, digging bell holes, excavating for footings and foundations, general excavation, and removing excess earth. It also includes trimming and grading, water re-

moval, shoring and bracing, backfilling and compacting, excavating and hauling fill, spreading and compacting fill, and general grading.

### DREDGING OPERATIONS

Included in dredging operations is preparation of a spoil area for dredged material as well as construction of dikes when required, setting and connecting discharge lines from dredge, dredge operations, barge operations,

and disconnecting and removing discharge lines. It also includes underwater excavation with a dragline or clamshell, hauling dredged material by truck or barge, and disposal of material.

## BASE AND SUBBASE PREPARATION

Base and subbase preparation includes grading and smoothing, excavating, loading, hauling, spreading, rolling, sprinkling, and fine-grading selected material to form the base or subbase. A factor for compaction

(see Table 6-1 ) should be added to the computed compacted quantity to obtain the quantity of loose material that must be handled.

## GRAPHIC AIDS

Graphic aids are useful for estimating production rates for any repetitious construction operation that has several definable variables.

The variables may be arranged in graphic form as shown in Figure 6-1. The graphic form uses the direct reading capability of the nomogram or nomograph to show the relative effect of the variables on production.

### NOMOGRAPH

Seven variables are incorporated into one graphic representation in the earth-moving nomogram (Figure 6-1 ). Two variables were fixed: capacity at 5 cubic yards per truck and time at 10 hours per day. The time delay per trip, distance, speed, number of trucks, and total volume hauled per day were then progressively locked into the nomograph to form this unique estimating tool.

### EXAMPLE

*Find the volume of earth in cubic yards hauled per 10-hour day in 20 trucks, each averaging 5 cubic yards per trip, and with an average time delay of 30 minutes, average speed of 25 miles per hour (mph), and an average haul distance of 7.5 miles.*

Using the nomograph (Figure 6-1) to find the volume, follow the broken line 30 - A - B - C - D - E - F .

- Average time delay per truck per trip for loading, dumping, maintenance, and contingency during a 10-hour workday is 30 minutes. Enter nomograph at average time delay of 30.
- Average speed is 25 mph. Project average delay time of 30 to 25 mph - A.

**Table 6-1. Typical earth - volume conversion factors**

Soil type	Initial soil condition	In place	Converted to:	
			Loose	Compacted
Sand	In place	--	1.11	0.95
	Loose	0.90	--	0.86
	Compacted	1.05	1.17	--
Loam	In place	--	1.25	0.90
	Loose	0.80	--	0.72
	Compacted	1.11	1.39	--
Clay	In place	--	1.43	0.90
	Loose	0.70	--	0.63
	Compacted	1.11	1.59	--
Rock (blasted)	In place	--	1.50	1.30
	Loose	0.67	--	0.87
	Compacted	0.77	1.15	--

For 5 cubic yards/truck/10-hour day

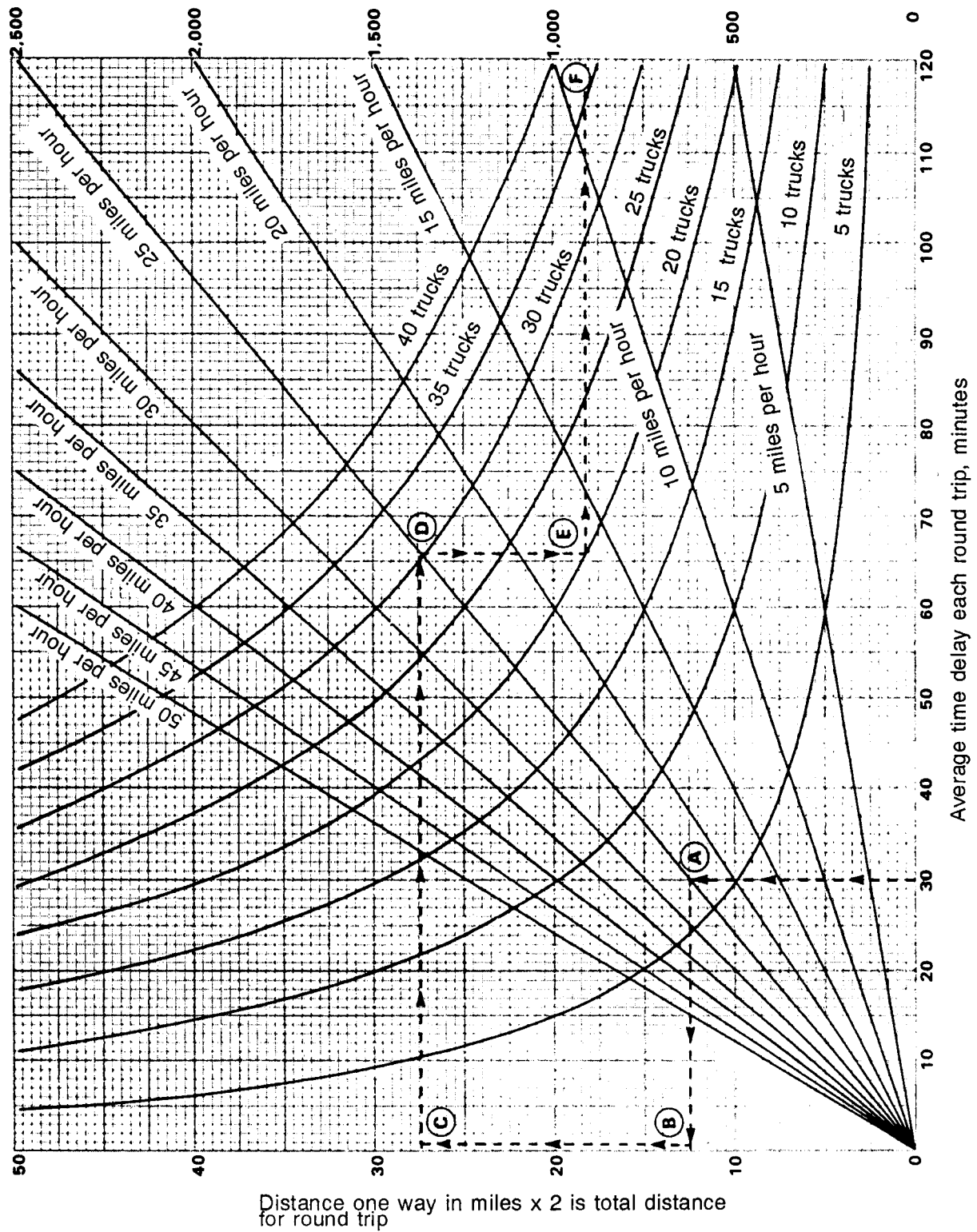


Figure 6-1. Earth-moving nomograph

- Read across to distance equivalent - 12.5 miles - B.
- Average haul distance is 7.5 miles. Double for round trip. Combined distance, D, is 27.5 miles - C.
- Project to 25 mph (speed) - D.
- Twenty 5-yard trucks are used - E.
- Read across to production line, V - cubic yards hauled is 910 cubic yards per day - F.

Check by computation:

t = time delay/trip, minutes	= 30 minutes
S = speed	= 25 mph
d = distance one way	= 7.5 miles
N = number of trucks	= 20 trucks
Q = quantity per truckload	= 5 cu yd
H = hours/day haulage	= 10 hrs/day
V = volume hauled/day, cubic yards =	(To be determined)

Then,

$$V = \frac{S}{S(t/60) + 2d} NQH$$

$$V = \frac{25 \text{ mph}}{25 \text{ mph} (30 \text{ min}/60 \text{ min per hour}) + (2 \times 7.5 \text{ miles})} \times 20 \text{ trucks} \times 5 \text{ cubic yards per truck} \times 10 \text{ hrs per day}$$

$$V = \frac{25 \text{ mph}}{27.5 \text{ miles}} 1,000 \text{ cubic yards per day}$$

$$V = 909.09 \text{ cubic yards per day or } 910 \text{ cubic yards per day}$$

## ESTIMATING TABLES

Tables 6-2 through 6-7, pages 6-5 through 6-10, may be used in preparing machine and man-hour estimates for earth moving. These tables are off-site estimating data, not exact figures. Since the variables affecting earth moving are many, much consideration should be given to situations and conditions varying from the norms these tables are based upon. A table on soil variation conversion factors (Table 6-8, page 6-10) and a table on boom swing angle conver-

sion factors (Table 6-9, page 6-11) should be used when necessary. These are only two variables of many that must be considered. The prevailing conditions and situations will always govern earth-moving estimates. Other conversion factors are listed in Tables 6-10 through 6-14, on pages 6-12 through 6-15.

**Table 6-2. Site preparation - clearing and grubbing**

Work element description	Tree diameter (in inches)	Equipment	Unit	Hours/unit (Rate in equipment hours)
<b>Machine work:<sup>1</sup></b>				
Light clearing		D7 dozer	1,000 sq yd	0.84
		D8K dozer	1,000 sq yd	0.69
Medium clearing	1 - 5	D7 dozer	1,000 sq yd	1.70
		D8K dozer	1,000 sq yd	1.10
Difficult clearing (For trees and stumps, good conditions, good traction, no steep slopes.)	6 - 12	D7 dozer	10 ea	0.50 - 1.50
		D8K dozer	10 ea	0.33 - 1.00
	13 - 30	D7 dozer	10 ea	0.85 - 3.50
		D8K dozer	10 ea	0.85 - 3.50
	over 30	D7 dozer	10 ea	1.50 - 5.50
		D8K dozer	10 ea	2.00 - 6.00
<b>Handwork:<sup>2</sup></b>				<b>(Rate in man-hours/unit)</b>
Light clearing		Axes, brush hooks, hatchets, machetes	100 sq yd	2.50
Medium clearing		Axes, cross saws	100 sq yd	5.00
Cutting large trees: (Removing branches, cutting into short lengths)	8 - 12	Axes, cross saws	ea	9.00 - 12.00
	13 - 18	Crew = 4 workers	ea	12.00 - 16.00
	19 - 24		ea	20.00 - 24.00
	25 - 36		ea	26.00 - 30.00
	8 - 12	Chain saws, axes	ea	2.00 - 3.00
	13 - 18	Crew = 3 workers	ea	3.00 - 4.00
	19 - 24		ea	5.00 - 6.00
	25 - 36		ea	6.00 - 8.00
Removing stumps	8 - 12	Picks, shovels, axes	ea	8.00
	13 - 18	Crew = 3 workers	ea	10.00
	19 - 24		ea	12.00
	25 - 36		ea	15.00
Blasting trees		Demo	10 ea	1.50
Blasting stumps		Demo, sledge hammer, priming stake. Crew = 3 workers	ea	1.00
Piling and burning		Labor	100 sq yd	0.80

<sup>1</sup>Typical crew: 1 crew leader, 1 dozer operator, and 2 to 5 workers with chain saws and axes cutting and trimming.

<sup>2</sup>Typical crew: 1 crew leader, 4 to 8 workers with brush hooks and axes, 1 to 2 workers with portable chain saws, and 2 to 5 workers burning.

**Table 6-3. Site preparation - earth moving, cutting, and filling**

Work element description		Equipment	Unit	Hours/unit (Rates in equipment hours)
<b>Machine work:<sup>1</sup></b>				
Excavate and load into trucks		Power shovel - 3/4-yd <sup>2</sup>	1,000 cu yd	9.00
		Dragline - 3/4-yd <sup>2</sup>	1,000 cu yd	12.00
		Clamshell - 3/4-yd <sup>2</sup>	1,000 cu yd	17.00
One-way distance: 50 ft		Scoop loader - 2 1/2-yd	1,000 cu yd	3.50
		- 5-yd	1,000 cu yd	7.00
100 ft		Scoop loader - 2 1/2-yd	1,000 cu yd	5.20
		- 5-yd	1,000 cu yd	10.40
200 ft		Scoop loader - 2 1/2-yd	1,000 cu yd	7.10
		- 5-yd	1,000 cu yd	14.20
300 ft		Scoop loader - 2 1/2-yd	1,000 cu yd	10.40
		- 5-yd	1,000 cu yd	20.80
Haul in trucks:		5-ton dump <sup>3</sup>	1,000 cu yd	42.00
(Assume approximately 4 cycles per hour)		20-ton dump <sup>3</sup>	1,000 cu yd	17.50
Excavate, load, haul (round trip) cycle time:				
3 min		18-yd scraper	1,000 cu yd	3.50
5 min		18-yd scraper	1,000 cu yd	5.60
7 min		18-yd scraper	1,000 cu yd	7.80
10 min		18-yd scraper	1,000 cu yd	11.10
Strip topsoil/stockpile soil, shallow excavation		D7 dozer	1,000 cu yd	35.00
		D8K dozer	1,000 cu yd	22.60
Spread fill		D7 dozer	1,000 cu yd	15.00
		D8K dozer	1,000 cu yd	9.60
Sprinkle		1,000-gal distributor	1,000 sq yd	0.04
Compact 2 passes		Sheepsfoot roller	1,000 sq yd	0.19
4 passes		113 in wide (2 rollers)	1,000 sq yd	0.39
6 passes			1,000 sq yd	0.58
<sup>1</sup> Crew: Crew leader and machine operators/dump-truck drivers as required or available.				
<sup>2</sup> See Table 6-8 for conversion factors for swing angle.				
<sup>3</sup> To use for other than 4 trips/hour, calculate cycle time and use appropriate proportions.				
Example: Cycle time of 20 minutes = 3 trips/hour. Then (4 trips/hour)(42 hours) = (3 trips/hour)(? hour) = 56 equipment hours/1,000 cubic yards.				

**Table 6-4. Trenching, ditching, and backfilling**

Work element description		Equipment	Unit	Hours/Unit
<b>Machine work:<sup>1</sup></b>				<b>Rates in equipment hours</b>
Trench and ditch excavation		SEE	1,000 cu yd	144.00
Backfill		CAT 130 grader	1,000 cu yd	2.00
Compact	2 passes	Sheepsfoot roller	1,000 sq yd	0.19
	4 passes	10 feet wide (2 rollers)	1,000 sq yd	0.39
	6 passes		1,000 sq yd	0.58
"V" ditching	Easy	CAT 130 grader	1,000 cu yd	3.70
	Medium	CAT 130 grader	1,000 cu yd	6.40
	Hard	CAT 130 grader	1,000 cu yd	11.50
<b>Handwork:<sup>2</sup></b>				<b>Rates in man-hours</b>
Excavation (6 ft max depth)		Shovels, pick	cu yd	1.75
Bell holes			10 ea	1.00
Backfill		Shovels	cu yd	0.75
Tamp		Pneumatic tamp	cu yd	0.70
Shoring walls				
Excavation depth: 5 - 8 ft		Sheet piling, lumber, nails,	100 sq ft	16.00
10 - 15 ft		hammers, saws	100 sq ft	20.00

<sup>1</sup>Crew: 1 crew leader and operators as required or as available.

<sup>2</sup>Typical crew: 1 crew leader, 2 to 10 workers excavating, 1 to 2 workers bell holes, and 2 to 8 workers backfilling and tamping.

Table 6-5. Excavation for footings and foundations and general excavation

Work element description	Equipment	Unit	Hours/unit
<b>Machine work:<sup>1</sup></b>			<b>Rates in equipment hours</b>
Excavate and load into trucks	Power shovel - 3/4-yd <sup>2</sup>	1,000 cu yd	9.00
	Dragline - 3/4-yd <sup>2</sup>	1,000 cu yd	12.00
	Clamshell - 3/4-yd <sup>2</sup>	1,000 cu yd	17.00
One-way distance: 50 ft	Scoop loader - 2 1/2-yd	1,000 cu yd	2.70
	- 5-yd	1,000 cu yd	1.35
100 ft	Scoop loader - 2 1/2-yd	1,000 cu yd	4.00
	- 5-yd	1,000 cu yd	2.00
200 ft	Scoop loader - 2 1/2-yd	1,000 cu yd	5.40
	- 5-yd	1,000 cu yd	2.70
300 ft	Scoop loader - 2 1/2-yd	1,000 cu yd	8.00
	- 5-yd	1,000 cu yd	4.00
Trimming	CAT 130 grader	1,000 cu yd	6.40
Haul with trucks:	5-ton dump	1,000 cu yd	42.00
(Assume approximately 4 round trips per hour)	20-ton dump	1,000 cu yd	19.50
Spread spoil pile	D7 dozer	1,000 cu yd	15.00
	D8K dozer	1,000 cu yd	9.20
Spread excess earth	D7 dozer	1,000 cu yd	28.20
	D8K dozer	1,000 cu yd	17.20
Backfill	D7 dozer	1,000 sq yd	17.80
	D8K dozer	1,000 sq yd	11.00
Compact 2 passes	Sheepsfoot (2 drums abreast)	1,000 sq yd	0.19
	Tamping foot	1,000 sq yd	0.10
4 passes	Sheepsfoot (2 drums abreast)	1,000 sq yd	0.39
	Tamping foot	1,000 sq yd	0.20
6 passes	Sheepsfoot (2 drums abreast)	1,000 sq yd	0.58
	Tamping foot	1,000 sq yd	0.29
Grading: (Digging side ditches, shaping crown, smoothing, and such) 4 round trips	CAT 130 grader	1,000 sq yd	0.10
<b>Handwork:<sup>3</sup></b>			<b>Rates in man-hours</b>
Excavate and load into trucks	Picks, shovels	cu yd	3.00
Spread loose soil	Shovels	cu yd	0.33
Backfill, shovel only	Shovels	cu yd	1.33
Backfill and tamp	Shovels, pneumatic tamp	cu yd	2.50
Haul up to 150 ft	Wheelbarrow	cu yd	1.00
Trim and fine grade	Shovels, rakes	100 sq yd	2.00
Shoring for basements, foundations, and such			
Depth: 8 - 12 ft	Lumber, sheet piling	100 sq ft	25.00
14 - 20 ft	Nails, hammers, saws	100 sq ft	30.00
8 - 12 ft	With pneumatic hammers	100 sq ft	21.00
14 - 20 ft	With pneumatic hammers	100 sq ft	26.00

<sup>1</sup>Typical crew: 1 crew leader, 2 workers on excavation equipment, 2 to 6 workers on haul equipment, 1 worker on compact equipment, and 1 worker on grading equipment.

<sup>2</sup>See Table 6-8, page 6-10, for conversion factors for swing angle.

<sup>3</sup>Typical crew: 1 crew leader; 2 to 10 workers excavating, loading, spreading, backfilling, compacting, trimming, fine grading, and tamping; and 2 or more workers shoring.



Table 6-6. Preparing subbase and base

Work element description		Equipment	Unit	Hours/unit
Machine work: <sup>1</sup>				Rates in equipment hours
Subbase:				
Scarify and shape	Scarify	D7 dozer with rippers	1,000 sq yd	3.11
		D8K dozer with rippers	1,000 sq yd	2.00
Compact	Shape	CAT 130 grader	1,000 sq yd	2.50
		Sheepsfoot (2 drums abreast)	1,000 sq yd	0.19
	2 passes	Tamping foot	1,000 sq yd	0.10
		Sheepsfoot (2 drums abreast)	1,000 sq yd	0.39
	4 passes	Tamping foot	1,000 sq yd	0.20
		Sheepsfoot (2 drums abreast)	1,000 sq yd	0.58
	6 passes	Tamping foot	1,000 sq yd	0.29
		9-tire pneumatic tire roller	1,000 sq yd	0.25
	2 passes	9-tire pneumatic tire roller	1,000 sq yd	0.49
	4 passes	9-tire pneumatic tire roller	1,000 sq yd	0.74
	2 passes	2-axle, 5-8 ton tandem roller	1,000 sq yd	0.29
	4 passes	2-axle, 5-8 ton tandem roller	1,000 sq yd	0.58
	6 passes	2-axle, 5-8 ton tandem roller	1,000 sq yd	0.89
	Base Course: Spread material			
		D7 dozer	1,000 cu yd	3.11
		D8K dozer	1,000 cu yd	2.00
Shape surface				
		CAT 130 grader	1,000 cu yd	5.00
		CAT 130 grader	1,000 sq yd	2.22
Compact gravel				
	10 passes	Tandem roller, 8-ton	1,000 sq yd	1.33
		Rubber-tired roller	1,000 sq yd	2.50
Handwork: <sup>2</sup>				Rates in man-hours
Spread, sprinkle, and compact		Shovels, pneumatic tamps	cu yd	2.00
Fine grade, sprinkle, and compact		Rake, shovel, pneumatic tamp	sq yd	0.20

<sup>1</sup>Typical crew: 1 crew leader; 2 to 4 workers on loading and shaping equipment; 2 to 6 workers on hauling equipment; and 3 to 5 workers on spreading, sprinkling, compacting, and fine-grading equipment.

<sup>2</sup>Crew: 1 crew leader and 2 to 10 workers spreading, sprinkling, compacting, and fine grading.

<sup>1</sup>Typical crew: 1 crew leader; 2 to 4 workers on loading and shaping equipment; 2 to 6 workers on hauling equipment; and 3 to 5 workers on spreading, sprinkling, compacting, and fine-grading equipment.

<sup>2</sup>Crew: 1 crew leader and 2 to 10 workers spreading, sprinkling, compacting, and fine grading.

Table 6-7. Underwater excavation

Work element description	Equipment	Unit	Hours/Unit
<b>Machine work:<sup>1</sup></b>			<b>Rate in equipment hours</b>
Build dike around spoil area <sup>2</sup>			
Operate dredge	Hydraulic dredge	1,000 cu yd	10.0
Underwater excavation	Clamshell - 3/4-yd	1,000 cu yd	25.0
	Dragline - 3/4-yd	1,000 cu yd	17.0
Spoil disposal: (Truck: Assume 6 cu yd/truck, 4 round trips/hr)	5-ton dump	1,000 cu yd	42.0
Spoil disposal: Barge	Barge with clamshell <sup>3</sup>	1,000 cu yd	50.0
	Barge with dragline <sup>3</sup>	1,000 cu yd	33.3
			<b>Rates in man-hours</b>
Install and remove discharge lines (hand work)	Hydraulic dredge	100 lin ft	10.0

<sup>1</sup>Typical crew: 1 crew leader; 4 to 7 workers installing and removing discharge lines; 3 to 5 workers per shift operating dredge (usually operated on a 2- or 3-shift basis around the clock); and 1 worker with equipment building dike with 3 workers installing drainpipes through dike. For dragline or clamshell excavation, 1 operator and signal person on dragline, 2 to 5 trucks with operators hauling spoil, 1 worker to direct loading of spoil on barge, 2 barges (1 loading and 1 unloading), 2 workers and 1 bulldozer unloading barge at disposal area, and 1 tugboat and crew (usually 3 to 5 workers).

<sup>2</sup>See earth-moving tables.

<sup>3</sup>Assume rotation of 2 barges per machine with short haul distance.

Table 6-8. Conversion for soil variables

Soil type	Type machine efficiency factors					Hand efficiency factors
	3/4-yd power shovel	3/4-yd dragline	3/4-yd clamshell	2 1/2-yd scoop loader	SEE	Manual
Loose sand-clay or moist loam	0.82	0.81	0.74	0.77	0.72	0.65
Sand-gravel	0.88	0.84	0.83	0.83	0.81	0.75
Good common earth	1.00	1.00	1.00	1.00	1.00	1.00
Hard, tough clay	1.23	1.17	Not recommended	1.26	1.25*	1.29
Rock, well blasted	1.43	Not recommended	Not recommended	Not recommended	Not recommended	Not recommended
Wet clay	1.93	1.91	Not recommended	Not recommended	Not recommended	Not recommended
Rock, poorly blasted	2.70	Not recommended	Not recommended	Not recommended	Not recommended	Not recommended

\*Recommended with multitooth bucket only.

**NOTE:** Earth-moving tables are compiled using "good common earth" as a norm. Therefore, to use this table, figure as follows:  

$$\text{Hours required} = \{(\text{quantity to be excavated}) / \text{unit}\} \times \text{unit hours required} \times \text{efficiency factor}$$

**Table 6-9. Conversion for swing angle at optimum depth**

Equipment	Swing angle in degrees							
	30	45	60	75	90	120	150	180
Dragline	0.76	0.84	0.90	0.95	1.00	1.10	1.21	1.30
Clamshell	0.76	0.84	0.90	0.95	1.00	1.10	1.21	1.30
Power shovel	--	0.80	0.86	0.93	1.00	1.14	1.27	1.41

**NOTES:**

1. Earth-moving tables are compiled using 90° swing angle.
2. Table use: *New rate in hours = rate of excavation to be used x swing angle-factor*

**Table 6-10. Material weights and swell factors**

Material	Number per cubic yard (loose)	Number per cubic yard (in place)	Percent of swell	Swell factor
Cement, Portland	2,450	2,950	20	0.83
Clay, natural red	2,700	3,500	30	0.77
Clay and gravel, dry	2,300	3,100	34	0.74
Clay and gravel, wet	2,600	3,500	34	0.72
Concrete	2,650	3,700	40	0.72
Concrete, wet mix	3,600	3,600	40	0.72
Earth, dry loam	2,300	2,850	25	0.81
Earth, wet loam	2,750	3,400	24	0.81
Granite	2,800	4,560	65	0.60
Gravel, 1/4- to 2-in, dry	2,850	3,200	12	0.89
Gravel, 1/4- to 2-in, wet	3,200	3,600	13	0.89
Laterite	3,900	5,200	33	0.75
Limestone, blasted	2,500	4,250	69	0.59
Limestone, crushed	2,700	4,500	67	0.60
Limestone, marble	2,700	4,550	69	0.59
Mud, dry	2,100	2,550	21	0.82
Mud, wet	2,650	3,200	21	0.83
Sand, dry	2,750	3,100	13	0.89
Sand, wet	3,150	3,600	14	0.88
Sandstone, shot	2,700	4,250	58	0.64
Shale, riprap	2,100	2,800	33	0.75
Slate	3,600	4,700	30	0.77
Coral, class #2, soft	1,760	2,900	65	0.61
	2,030	3,350		
Coral, class #1, hard	2,030	2,900	67	0.60
	2,440	4,075		

**NOTES:**

1. Percent of swell times the bank (in place) cubic yards equals the loose cubic yards to be moved.
2. Swell factor times the loose cubic yards equals bank cubic yards being moved.
3. Compaction factor times the volume of the fill equals the loose material required for compacted fill.

Trench depth (inches)	Trench width, inches						
	12	18	24	30	36	42	48
Content of trench, cubic yards per 100 linear feet							
6	1.9	2.8	3.7	4.6	5.6	6.6	7.4
12	3.7	5.6	7.4	9.3	11.1	13.0	14.8
18	5.6	8.3	11.1	13.9	16.7	19.4	22.3
24	7.4	11.1	14.8	18.5	22.2	26.0	29.6
30	9.3	13.8	18.5	23.2	27.8	32.4	37.0
36	11.1	16.6	22.2	27.8	33.3	38.9	44.5
42	13.0	19.4	25.9	32.4	38.9	45.4	52.0
48	14.8	22.2	29.6	37.0	44.5	52.0	59.2
54	16.7	25.0	33.3	41.6	50.0	58.4	66.7
60	18.6	27.8	37.0	46.3	55.5	64.9	74.1

**Table 6-12. General excavation factors**

Depth	Cubic yards to be removed per square foot of area
2 in	0.006
4 in	0.012
6 in	0.018
8 in	0.025
10 in	0.031
1 ft	0.037
1 1/2 ft	0.056
2 ft	0.074
2 1/2 ft	0.093
3 ft	0.111
3 1/2 ft	0.130
4 ft	0.148
4 1/2 ft	0.167
5 ft	0.185
5 1/2 ft	0.204
6 ft	0.222
6 1/2 ft	0.241
7 ft	0.259
7 1/2 ft	0.278
8 ft	0.296
8 1/2 ft	0.314
9 ft	0.332
9 1/2 ft	0.350
10 ft	0.369

Example:  
Assume that an excavation is 24 feet x 30 feet and 6 feet deep ( $24 \times 30 = 720$ ). In the table, the 6-foot depth has a factor of 0.222 (the number of cubic yards in an excavation 1 foot square and 6 feet deep). Therefore,  $720 \times 0.222 = 159.84$  cubic yards.

**Table 6-13. Front-end-loader production**

Excavation from pit to truck pile (hourly production)				
Bucket size	Haul distance			
	50 feet	100 feet	150 feet	200 feet
	Cubic yards			
1 1/4	39	28	21	17
2 1/2	124	92	75	62
5 1/2	312	244	200	167

**NOTE:** Figures are in loose cubic yards. Use Table 6-1 to find the amount of bank cubic yards (in place) removed per hour.

**Example:**  
 2 1/2 cubic yards loader at 50' haul = 124 loose cubic yards.  
 124 cubic yards x swell factor for earth, loam, dry = 124 x 0.81 = 100 bank cubic yards in one hour.

**Table 6-14. Bulldozer production**

Loose cubic yardage hourly production (based on 50-minute hour)						
Dozer size	Haul distance					
	50 feet	100 feet	150 feet	200 feet	250 feet	300 feet
	Cubic yards					
Large (D-8/TD25)	435	285	210	170	125	95
Medium (D-7/TD20)	370	205	155	100	74	55
Small (D-4/TD9)	105	65	46	34	22	--

**NOTES:**  
 1. Figures are in loose cubic yards. Use Table 6-1 to find the amount of bank cubic yards (in place).  
 2. Production is based on slot dozing. If work is done without slots, reduce figures by 25 percent.